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ScienceDirect

Procedia - Social and Behavioral Sciences 119 (2014) 529 – 538

Procedia
Social and Behavioral Sciences

27th IPMA World Congress

Challenges for the Implementation of Integrated Design in the Planning Practice

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Abstract

Design and planning process of "green buildings" requires a fundamental change in traditional design planning process, towards more integrated, collaborative practice with life-cycle orientation. The methods known from aeronautical and automotive industry such as concurrent engineering have often been referred to as possible way for radical process improvement of AEC industry, however the implementation of the so called integrated building design (IBD) in the planning practice has not succeeded yet. This paper will present the results of the multiple case study research of best-practice planning processes for five energy efficient buildings, with aim to determine the success factors, optimization potentials and deficits of the processes. The findings identify the early evolvement of stakeholders, interdisciplinary, simultaneous collaboration and transparency in communication and information as success factors. The findings were verified in the practitioners' workshop, where as particularly important step for the implementation, the change of fee structure for architects and engineers (FSAE) and scope of services were identified.

Keywords: Integrated Design; Collaborative Planning; Sustainability; Energy Efficiency

1. Introduction

The implementation of energy efficiency in the built environment is already embedded in the public policy – by the 2020 new buildings have to be realised as Nearly Zero Energy Buildings (EBPD, 2010). Numerous building

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doi:10.1016/j.sbspro.2014.03.059

certificates and initiatives in AEC industry call for life cycle optimisation and holistic approach for realization of sustainability aims. A shift from traditional, sequential design towards more integrated planning practice is has been recognised as a necessary step for achievement of resources and energy efficient built environment.
Integrated building design (IBD) is advocated as suitable approach for achievement of sustainability aims. This method enables early collaboration of project stakeholders and therefore the performance-optimization in the earliest planning phase, which has the largest influence on the latter building performance. The interactions between project stakeholders on multiple levels (in virtual environment using ICT tools or in real environment in collaborative workshop setting), support in such way transfer of information of different richness-levels, creation of new knowledge, and therefore of innovation in a holistic manner (Fisscher et al, 2012, Dossik et al, 2012).
The customary building certificates include the assessment of utilization of integrated planning, which is reflected in the relevant indicators.
AEC industry is much focused on regional or local level, and strongly constrained by its requirements and traditions, this especially being so in the Central European region with very strong engineering tradition largely relying on expertise of singular disciplines. A knowledge or experience in collaborative planning process for energy-efficient buildings using integrated design method is still largely lacking.
In order to gain knowledge on potentials and deficits of current planning processes for energy efficient buildings, and propose a framework for implementation of IBD in planning practice, we conducted multiple case study research of certified, best-practice energy-efficient buildings. Thereby the success factors, as well as improvement potentials and obstacles were identified through interviews with planning process stakeholders, observation and informal communication. The results were compared to the key performance indicators for integrated planning identified in the literature, which mostly relies on the concurrent engineering method. As final result, a guideline for investors, planners and public policy for IBD was developed.
This paper is structured as follows – after outlining the current shift in the planning practice from segmentation towards integration, in the second part we will briefly outline the development of integrated planning from its origin in concurrent engineering method. The current state of the art will be demonstrated; several industrial documents promoting IBD will be presented and discussed. We proceed with the presentation of the cases, research methods and assessed data in the third part, and present the results in the fourth part. We will conclude with discussion on necessary future steps for implementation of IBD in the planning practice in the fifth, concluding part.

2. Development of Integrated Planning Methods

A bulk of literature presents benefits of concurrent engineering method in the industry, as predecessor of integrated building design, however there is still little knowledge on actual planning and construction process for sustainable buildings using integrated whole building design.
Concurrent engineering (CE) as a method was originally introduced in the 1980ies with the major aim of increasing companies' competitiveness through reduction of the product development lead-time while simultaneously reducing costs and improving quality (Sohlenius, 1992). The method was developed to improve the time-to-market performance, as the product life-cycles were rapidly decreasing (Koufteros et al, 2001). In order to improve the success of the introduction of new products, the shift, from the traditional sequential succession of sub-tasks with a minimum of interaction between constituents of each sequence, towards integration of the conceptual design stage and process- and production- design phases was introduced (Solehnius, 1990). Penner and Winner define CE as: "The concurrent engineering can be defined as a systematic approach to the integrated, concurrent design of products and related process, including manufacturing and support. This approach is intended to cause developers to consider all elements of the product life cycle from conception to disposal, including quality, cost, schedule, and user requirements" (Pennel and Winner, 1989).
As the main pillars of CE the concurrent workflow, i.e. early involvement of participants and teamwork, can be identified (Koufteros et al, 2001, Valle and Vazquez-Bustello, 2009). The concurrent workflow enables overlapping of product- and process-design phases, the time of each activity is not necessarily reduced, but through overlapping activities the overall time is drastically decreased. Simultaneous design, prototyping and testing, so that manufacturability can be evaluated at much earlier stage, result with early detection of major failures of

conceptual design, reduced changes and shorter overall development times. Early involvement of constituents enables the maximization of information-input at the beginning of development, when opportunities are greatest, feedback from multiple sources can reduce information gaps and contributes to higher product integrity (Valle and Vazquez-Bustelo, 2009). Teamwork means that participants work closely together, bound through common goals, with a high degree of transparency, shared risks and rewards (Jassawalla and Sashittal, 1998), strongly supported by the computer and information and communication technology tools and platforms (Prasad et al 1998, Wang et all, 2002).

2.1. Integrated Design in the Planning Practice

Several AEC-industry planning guidelines introduce the integrated design method, based on concurrent engineering principles, such as for example Integrated Whole Building Design or Integrated Project Delivery.

The New Zealand Ministry for the Environment proposed the 'Integrated Whole Building Design Guidelines' (IWBD, 2008), for better achievement of sustainability goals. This guideline perceives the traditional design process is seen as linear succession of different design tasks, where minimal interaction between design team members is possible due to fragmentation. The structure is front-loaded, which discourages the design team members' involvement in later phases of construction, post-occupancy and feedback in the use of the building. The IWBD method is a holistic method, involving all stakeholders (planning team, users, tenants) from the early phases, which helps to recognize design opportunities, such as e.g. integrating the building services into the building structure. It is a design led approach, based on interconnectedness of the planning aims and life-cyclic view.

The innovative aspect of the 'Whole Building Design' method (Prowler, 2007) compared to CE is the consideration of sustainability issues. Achievement of sustainability goals, i.e. interests of ecology, economy and socio-cultural values, is only possible through collaboration of stakeholders representing their mutual interests, and in such a way different interests of sustainability.

Integrated Project Delivery (IPD) Guide (2007) by AIA is mainly efficiency driven, through time and cost efficiency, sustainability is seen mainly as energy-efficiency issue. It is, however, based on the same principles: mutual respect and trust in team work, mutual benefits and rewards, collaborative innovation and decision making, early involvement of key participants, early goal definition, intensified planning (increased effort in planning), open communication (no-blame culture), appropriate technology (open data exchange), organization and leadership (clearly defined roles).

Chachere, Kunz and Levitt (2004) work with the Integrated Concurrent Engineering Method (ICE) within a design-project class, which was developed upon NASA's concurrent design approach, with the main driver of radical development-time reduction. They claim that the limitation for speed of engineering processes is the response latency – or the waiting time in the communication between two experts (engineers) for a problem solution. The main focus here is on development of project-management tools for the reduction of lead time and improvement of the reliability. The key performance indicators are similar to the one defined by IPDG or IWBD: Flat organizational hierarchies, clear and congruent team goals, collegial and respectful team culture, low process equivocality, complete team knowledge network, committed participant focus, rich communication media, support by information technology for modelling and visualization.

2.2. Integrated Design in the Building Certificates

Building certificates see as their main task the increase in construction or refurbishment rate of "green buildings" on the real-estate market as well as to promote optimization of building performance in terms of resources efficiency and minimization of emissions. Most of the certificates already incorporate the assessment of the integrated planning method, through explicit accreditation of credits. It can be noted that only LEED is lacking the explicit indicator for integrated planning, however IPD is recommended as project delivery method.

Table 1. Integrated planning as an indicator in building certificates

TQB (2013)	BREEAM (2013)	LEED (2009)	DGNB (2009)
B.1.2 Integrated Planning and Variant Analysis	Man 01 Sustainable procurement Project brief and design Integrated design process	ID Credit 2: LEE D Accredited Professional	Process Quality: Crit. 44 Integrated Planning
Next to the calculation of cost effectiveness, an integrated, network-oriented planning with compilation of different planning variants represents a relevant basis for quality of a building.	„From design brief stage the client, building occupier, design team and contractor (see CN2) are involved in contributing to the decision making process for the project. As a minimum this includes meeting to identify and define their roles, responsibilities and contributions during the following phases: Design, Construction, Commissioning and handover Occupation, i.e. up to and including post practical completion stage."	Potential Technologies & Strategies Educate the project team members about green building design and construction, the LEED requirements and application process early in the life of the project. Consider assigning integrated design and construction process facilitation to the LEED AP.	Integrated planning team, Team-Qualification, Planning Process Guidelines, User Participation

3. Best-Practice Cases: Research Methods and Data-Assessment

In our exploration of the design and planning processes for the best-practice energy-efficient buildings, we applied the practice-oriented multiple case study (Eisenhard, 1989) employing descriptive research method (Dulk and Hul, 2008). The research methods involved open-ended interviews with planning process participants, observation and informal communication. Based upon this research, project stories were compiled to reconstruct the design and planning process of the cases.

The examined cases include five office buildings in Austria and Germany constructed in the period from 2007 till 2012, build as showcase energy-efficient buildings; four of the cases being certified either DGNB or TQB. The cases feature ambitious energy-efficiency aims, such as passive-house or even energy-plus standard.

Table 2. Cases: Five best practice energy efficient office buildings

	Building A	Building B	Building C	Building D	Building E
Planning period	3/2010-3/2011	2004-2006	3/2006-4/2007	2007-2008	12/2006-3/2008
Construction	7/2011 – 8/2012	5/2007-6/2008	4/2007-6/2008	4/2008-7/2009	3/2008-11/2008
Size BGF	9.125m2	11.363m2	6.955m2	18.600m2 office and production	3.033m2
Certification	TQB Energy Plus	TQB Passive House	Flagship Project for EnEff	DGNB Silver Flagship	DGNB Bronze
Ownership	Lease	Lease	Own Use	Own Use	Own Use
Number of Interwiews/Who was interviewed	Investor, Architect, MEP eng., Structural eng., Energy Consultant	Investor, Architect	Architect, MEP eng Facility Management	Investor, Architect, MEP eng.	Project Manager, MEP eng.
End Energy Consumption	21kWh/m2 without PV	18,91kwh/m2	49,1 kwh/m2	64,2 kWh/m2	58kWh/m2

In order to capture different perspectives of planning process stakeholders, 19 open-ended interviews were carried out in the 2011 and 2012. The interview partners included investors, architects, structural and MEP engineers, facility manager and energy consultants. Through content analysis of the executed interviews (Bogner, 2010), the most often appearing statements in the interviews were identified and structured in the categories of success factors, optimization potentials and deficits of the best-practices. The analysis enabled comparison of the statements according to the profession (Table 3) and project-related (Table 4) comparison of the statements.

Table 3. Professions-related Interviews: Statements structured according to the profession and category: success factors, Optimization Potentials, Deficits

	Investor	Architect	Structural Eng.	MEP Eng.	Consultants
Success Factors	Early involvement of Planners, Consultants and Users	Interdisciplinarity/ Simultaneity	Transparent communication and information	Early involvement of Planners, Consultants and Users	Transparent communication and information
	Interdisciplinarity/ Simultaneity	Early involvement of Planners, Consultants and Users	Early involvement of Planners, Consultants and Users	Strong Involvement of Investor	Interdisciplinarity/ Simultaneity
	Transparent communication and information	Freedom of choice of planners	Interdisciplinarity/ Simultaneity	Interdisciplinarity/ Simultaneity	Early involvement of Planners, Consultants and Users
	Common aims	Transparent communication and information	Common aims	Flat hierarchy	Competences of stakeholders for „sustainable building“
	Optimization in Utilization Phase	Strong involvement of Investor	More freedom in choice of planners	Optimization in Utilization Phase	Regular/repeated cooperation
	Repeated/Regular cooperation	Professional management of communication	Trust	Transparent communication and information	Strong Investor, final decision maker
Optimization Potentials	Tools for decision support	Competences of stakeholders for „sustainable building“	Interdisciplinarity/ Simultaneity	Interdisciplinarity/ Simultaneity	Shift in planning priorities
	Transparent communication and information	Professional management of communication	Early involvement of Planners, Consultants and Users	Shift in planning priorities	Early involvement of Planners, Consultants and Users
	Early and joint aim setting (qualitative)	Shift in planning priorities	Better education/ Competencies in „sustainable building“	Transparent communication and information	Extended responsibilities of Investor
	Professional communication management	Early and joint aim setting (qualitative)	Transparent communication and information	Early involvement of Planners, Consultants and Users	More freedom of choice of planners
	Building Performance Optimization, Optimization in Utilization Phase	Holistic planning approach	Holistic planning approach	Expansion of Investors responsibilities	Better education in „sustainable building“
	Reduction of interfaces	Improvement of competencies in „sustainable building“	Reduction of interfaces	Reduction of interfaces	Business Advisers in Planning Phase
Deficits	Innovation-loss through inter-firm processes and communication	Wrong planning priorities	Lack of reliability (code of honour lacking)	Wrong criteria for formation/comissioning of planning team	Low flexibility level of planners
	Profit maximization as primary aim with large contractors (Claim Management)	Low competencies in „sustainable building“	Lack of trust	Innovation-loss through inter-firm processes and communication	Imprecise and belated definition of planning aims
	Conservative allocation of roles	Incompatible planning partners	Lack of Education/ Competencies in „sustainable building“	Belated involvement of planners and consultants	Belated involvement of planners and consultants
	Comissioning law	Low flexibility level of planners	Belated involvement of planners and consultants	Profit maximization as primary aim for large contractors (Claim Management)	Wrong planning priorities
	Knowledge gap (Pre-Competition/ Post-Competition)	Wrong criteria for formation/commissioning of planning team	Lack of knowledge on interdisciplinary collaboration	Wrong chronology in delivery of planning process	Lack of knowledge in „sustainable building“
		Commissioning law	Cost- and time pressure		Lack of guidelines for interdisciplinary collaboration

Table 4. Cases-related interviews: Positive and Negative Statements structured according to the case (building)

Building	Role	Positive Statements	Negative Statements
Building A	**Investor**	General planner (GP) form enabled inter-firm problem solutions	GP - preconceived solutions delivered by GP
			Lack of creative discussion with Investor, nobody contradicts the investor in GP setting
			Energy-efficiency was not valuated sufficiently by the competition jury
			Innovation loss through GP
	Struct. Eng.	MEP Eng. from the concept-phase	
		Good communication/holistic thinking	
		Kick-Off Meeting at the beginning	
		Super Investor - mutual trust	
		GP model: short routes	
	Cons.	No problems in communication	Planning team too large
			Many interfaces
			Research partners not committed
			No budget for team building
Building B	**Inv.**	Uncomplicated communication	
		main topics in focus	
	Arch.	Early involvement of MEP Eng.	MEP Eng. involved too late
		2-weekly Jour Fixe	Architect and MEP hat not enough knowledge on innovative energy concepts
			Lack of tools for decision making support
			Difficult communication between disciplines due to the different vocabulary
			Monitoring should be scientifically assessed and evaluated
Building C	**Inv.**	MEP Eng. in concept-phase	Lack of innovation drive from total contractor (TC) and sub-contractors
		Strong involvement of Investor with MEP concept	Construction failures
		Good communication climate	Change in commissioning - change of planning partners
		Strong engagement of single persons (MEP planners)	Commissioning of total contractor down sided the quality
		Enabling of financial buffers in early planning phases	Total contractor has exclusively economic interests
		Monitoring and Jour Fixe for optimization	
	Arch.	Holistic approach of project partners and MEP Eng.	Double-ended commissioning ends in poor performance
		Life cycle oriented procurement (operation costs considered)	TC hardly was involved in development of innovative concepts
		Simultaneous planning, very intensive contact with planners	Fights between disciplines (Planning ambitions vs. Profit-orientation)
		Excellent communication with investor	Information break through commissioning of TC in the middle of the process
			Greatest difficulty - lack of skills on the TC side
			TC cost calculation based on standard values, instead of innovative construction
	MEP E.	Strong engagement of investor, visionary architect	Bad communication - blaming, claims
		Intensive, early dialogue with architect, employment of cooling consultant	TC identified as originator for bad communication climate
		Monitoring and regulation of building operation (on investor side)	TC has no understanding for innovative concepts
		MEP Eng. before compilation of tender documentation in the team	Lack of commitment of the TC side

		Users involved in decision making process	Change of construction drawings after TC commissioning
Building D	Inv.	High competences of architect, personal liking	Sometimes the things were discussed differently than they were later realised
		General planer -all disciplines in house	Would have made gold-certificate if certified from the beginning of the process, and not in Post-planning
		2 persons assigned for sustainability consulting	In important phases insufficient capacities on the investor phase
		GP experienced in "sustainable building"	
		Highly motivated MEP, motivation for the whole team	
		Kick-Off Weekend in the early phase	
		Planners and Investor align on personal base	
		GP has revealed the lacking planning aims by investor - positive, since re-start possible	
	Arch.	Very intensive contact with investor	Investor did not deliver the client brief
		Trust in Investor and Team - act as one team	Unforeseen costs
			Post-planning certification difficult
Building E	Inv.	Since all planners in house – early dialogue possible	Conservative role-assignment on the architect and engineers' sides
		User involved in conceptual planning	Sustainability criteria were not considered in the early stages
		Key to successful planning process early involvement of users and planners	
		Energy concept compiled in early cooperation with users and planners	
		Communication climate very good, everybody pulling together	
		Architect and Engineers working with same CAD software	
		Communication is the most important aspect, especially transparency	
		When commissioning TC, working together in the past is important for trust	
		Joint aim setting at Kick Off Meeting	
	Struct. E.	Due to the former long lasting cooperation experience, very good cooperation and open communication	

4. Discussion of Results

Based upon the conducted interviews in combination with the analysis of project data and formal and informal communication, for the visualisation of results for each case a project story in form of flow-chart was compiled. The project story comprises important phases, milestones and disturbances, and significant statements of the stakeholders. The visualization through project story enables the comparison of the cases in terms of time, commissioning forms, disturbances etc.

On the example of the case D, the disturbance in the planning process was caused by the fact that investor missed delivering a client brief, and carried out an architectural competition without actual client brief. The problems related to the lacking of exact spatial and functional programme and floor-layout requirements became apparent after the predesign was completed. The client brief had to be commissioned, and the predesign re-worked, which caused a delay in the planning of four months, however has proved as very valuable for the overall project success, as the client expressed in the interview. "…the users and myself are very satisfied with the new building, despite the fact we had a few difficulties in the beginning to get used to it." And to the planning process: " Chronology went like this: got contract to do the job (lead the project), found the planner, the planner asked 'what do you really want?', went a step back, commissioned client brief with a consultant with whom we compiled a basic concept for the location. We have thought about some strategic decisions at that point. Important is, that step was initiated by us, not by the planner - the planner just asked what do we really want from the building?"

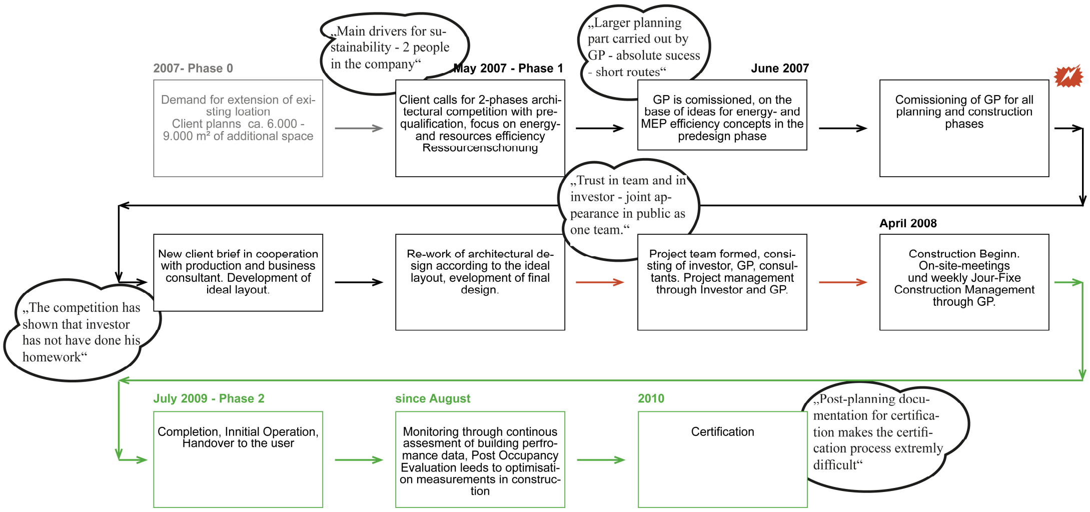

Fig 1. Project Story Case D

The results of the interviews imply on the crucial role of the investor, as driving force for the implementation of sustainability aims, but also for the overall project success. The **early involvement of stakeholders** is defined as success factor by all of the professions, together with interdisciplinarity/simultaneity and transparent communication and information.

There is no single criterion that all stakeholders would share when identifying the optimization potentials. The most shared criterion is optimization of transparent communication and information, of involvement of stakeholders in the early planning phases, and reduction of interfaces (shared in three professions out of five).

There is also no single criterion that all stakeholders would share when identifying the main deficits. Belated involvement of planners and consultants is an aspect shared by three out of five professions. Many issues concerning the planning culture can be identified, such as wrong planning priorities, profit orientation, EU comissioning low, conservative allocations of roles.

Flat organizational hierarchies, clear and congruent team goals, collegial and respectful team culture, low process equivocality, complete team knowledge network, committed participant focus, rich communication media, support by information technology (IT) for modelling and visualization, as the KPIs identified for integrated concurrent engineering by Cachere et al (2004), are basically all to be found in statements of the interviewees; with one exception of the IT. There is a wish for tools for support of decision-making, however they have not been explicitly assigned to the IT tools. This can be explained through the fact that the implementation of BIM tools in Central Europe is much slower than the entry of CAD was (McGraw Hill 2010), especially in the years when the interviews were carried out. The analysis of the case-related statements reveals many more statements related to the communication (Good communication/holistic thinking), commitment (Strong engagement of single persons (MEP planners)), trust (Trust in Investor and Team - act as one team) and personal engagement (Highly motivated MEP, motivation for the whole team).

Even though four out of five projects were certified either through DGNB or TQB certificate, the positive impact on the certification on the promotion of integrated planning could not be identified. Even more so, the certification was perceived as hindering for the process, if carried out as back-end process.

The stakeholders, who reported the “integrated” practice, were practicing it due to the striving for innovation; personal commitment and trust in team, much more than imposed through the certificate. Despite the wish by in the first line planners (architect and structural engineers) on holistic planning approach and for interdisciplinary

collaboration by all stakeholders, the interviewees themselves state that there is a lack of knowledge how to actually do it: "…different know-how on inter-firm communication and qualifications of stakeholders, low understanding for interdisciplinary cooperation…", says the architect of the case B.
The EU comissioning low is mainly seen as obstacle for interdisciplinary planning, limiting the freedom in choice of the planners.

5. Future steps

The results compiled through case study research were presented for verification in the framework of workshop with 17 practitioners, including architects, clients, MEP engineers and energy consultants in a moderated round-table setting. The practitioners reported the necessity for changing the current fee structure towards support of integrated planning process, in alignment to e.g. Swiss fee structure SIA, including the new description of scope of services in integrated planning process. Further on, models for incentives for partnering such as shared risks and benefits should be adopted.
Even though the research on integrated building design has been on going topic in intensive discussion in the academic community, especially in the fields of collaborative planning in AEC industry (Dossick and Neff 2011, Dewulf and Kaderfors 2012) integrated project delivery (Owen and Prins 2010, Owen et al 2010) and project-organizations engaged in collaborative practice (Hartmann and Bresnen 2011, Love et al 2010) the scientific models have hardly found adoption in the planning practice.
The Australian collaborative comissioning model (alliancing) has often been quoted by the industry as successful model for the integrative, partnering approach in design and construction. Chen at al (2012) define as main governance mechanisms target cost arrangement, financial risk and reward sharing regime, transparent financials and collaborative multi-party agreement. They also identify informal governance mechanisms as leadership structure, integrated team and joint management system. Love et al (2011) develop risk/reward model for compensation alliance in civil engineering infrastructure projects. They conclude that sharing of risk/reward is crucial for project success when using alliancing. However the evaluation within this research was carried out for large infrastructural projects. The future research should test the transferability of the collaborative comissioning models on the Central European market for design and construction of buildings. In order to transform the AEC industry, the scope of services for professionals engaged in integrated planning process should be defined on public policy and fee structures level.
As final result, we propose the Guidelines for Integrated Planning (Kovacic et al 2012) for investors, planners and public policy, which describe the mechanisms for design of integrated design process, based on tangible and intangible tools. As tangible tools building certificates, building information modelling (BIM) and life cycle assessment with life cycle cost and benefits, post occupancy evaluation methods are introduced. As intangible tools, the basics of client brief (programming), choice of planning team, communication design and management, team-building, decision-making process and know-how transfer are described as guideline for application in integrated building design process.
As building information modelling tools are increasingly emerging on the Central European Market, our future research will be dedicated to the analysis of BIM supported planning processes in relation to the BIM potentials to support the integration in building design, planning and construction. The research should evaluate the triangulation of people-process-technology bound capabilities and its impact on successful integrated building design.

Acknowledgements

The presented research was carried out within the funded research project "Cost Benefits of Integrated Planninng", at Vienna University of Technology. *This research was funded by the FFG (Austrian Research Promotion Agency) under grant No. 825618*. The authors gratefully acknowledge the support of Prof. Christoph Achammer and Dr. Hendrik Seibel, Department for Industrial Building and Interdisciplinary Planning, and project partners Department for Real Estate Development, Vienna University of Technology and ATP Sustain.

References

AIA (2007) Integrated Project Delivery: A Guide, American Institute of Architects California Council

AIA (2009), Experiences in Collaboration: On the Path to IPD. American Institute of Architects California Council, 5

Bogner, A. (2005) *Das experten Interview*, VS Verlag für Sozialwissenschaften, Wiesbaden

BREEAM (2013) BREEAM New Construction Non-Domestic Buildings, Technical Manual, BRE (Publisher), http://www.breeam.org/page.jsp?id=109, last acess June 2013

Chachere J., Kunz J. & Levitt R. (2004) The Role of Reduced Latency in Integrated Concurrent Engineering. CIFE Working Paper #WP116, April 2009, Stanford University

Chen L., Manley K. & Lewis J. (2012) Understanding Formal and Informal Governance on Infrastructure Projects, Technical report, Alliance Research Report

Dewulf G. and Kadefors A. (2012) Collaboration in public construction—contractual incentives, partnering schemes and trust. *Engineering Project Organization Journal*, 4 (2), 240-250

DGNB (2009), DGNB Handbuch Neubau Büro und Verwaltungsgebäude, Version 2009

Dul J., Hak T. (2008) *Case Study Methodology in Business Research*, Amsterdam: Elsevier

Dossick C., Anderson A., JIorio J. Neff G., and Taylor J. (2012) Messy Talk and Mutual Discovery: Exploring the Necessary Conditions for Synthesis in Virtual Teams. Working Paper Proceedings, Engineering Project Organizations Conference Rheden, The Netherlands

EBPD (2010) DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings

Eisenhard K. (1989) Building Theories from Case Study Research, *The Academy of Management Review*, 4 (14)., 532-550.

Hartmann A. & Bresnen M. (2011) The emergence of partnering in construction practice: an activity theory perspective. *Engineering Project Organization Journal*, 1 (1), 41-52

Fischer M., Stone M., Liston K., Kunz J., Singhal V.(2002) :Multi-stakeholder collaboration: The CIFE iRoom, International Council for Research and Innovation in Building and Construction, CIB w78 Conference 2002

IWHBD (2008). Integrated Whole Building Design Guildelines .New Zealand Government, Ministry for the Einvironment, www.mfe.govt.nz

Jassawalla A.R. and Sashittal H.C. (1998) An Examination of Collaboration in High-Technology New Product Development Processes. *Journal of Product Innovation Management*, 15 (3), 237-253

Koufteros X., Vonderembse M. & Doll W. (2001). Concurrent engineering and its consequences. *Journal of Operations Management*, 19, 97–115

Kovacic I., Achammer C., Müller C., Seibel. H, Wiegand D., Sreckovic M., Glöggler J., Kösegy S. & Filzmoser M. (2012) Leitfaden für Integrale Planung für Public Policy, Planer und Bauherrn, Technical report, Reserach Project Co_Be, Neue Energieen 2020

LEED (2009), LEED® 2009 for New Construction & Major Renovations v3.0, available at: www.usgbc.org/leed , accessed June 2013

Love, P., Davis, P., Chevis, R., and Edwards, D. (2011). "Risk/Reward Compensation Model for Civil Engineering Infrastructure Alliance Projects." J. Constr. Eng. Manage., 137(2), 127–136.

McGraw Hill (2010) SmartMarket Report. The Business value of BIM in Europe

Owen R., Amor R., Palmer M., Dickinson J., Tatum C.b., Kazi A.s, Prins M., Kiviniemi A., East B. (2010) Challenges for Integrated Design and Delivery Solutions, *Architectural Engineering and Design Management*, 6, 227-231 232-240

Pennell, J.P. & Winner, R.I. (1989). Concurrent engineering: practices and prospects. in: Global Telecommunications Conference, 1989, and Exhibition. Communications Technology for the 1990s and Beyond. GLOBECOM '89, IEEE. 1, 647 – 655

Prasad B.,Wang & F. Jiati Denget J. (1998) A Concurrent Workflow Management Process or Integrated Product Development. *Journal of Engineering Design*, 9 (2), 121-135

Prins M. and Owen R., (2010) Integrated Design and Delivery Solutions, *Architectural Engineering and Design Management*, 6, 227-231

Prowler D. (2007) Whole Building Design. http://www.wbdg.org/

Sohlenius G. (1992) Concurrent Engineering. CIRP Annals - Manufacturing Technology, 41(2), 645-655

TQB (2013), Total Quality Building, Österreichische Gesellschaft für nachhaltiges Bauen, https://www.oegnb.net/tqb.htm, last accessed June 2013

Valle S. & Vazquez-Bustelo D. (2009) Concurrent engineering performance: Incremental versus radical innovation. *Int. J. Production Economics*, 119, 136-148

Wang L., Shen W., Xie H., Neelamkavil J., Pardasani A. (2002) Collaborative conceptual design – state of the art and future trends, *Computer-Aided Design*, 34, 981-996